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FEM 1.209: 421309

MAR 11 1987

FLOOD INSURANCE STUDY



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ORIGINAL

TOWNSHIP OF
MANOR,
PENNSYLVANIA
ARMSTRONG COUNTY



MAY 19, 1987



Federal Emergency Management Agency

COMMUNITY NUMBER - 421309

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
TOWNSHIP OF MANOR, ARMSTRONG COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Manor, Armstrong County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Benatec Associates, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-84-C-1608. This work was completed in December 1985.

1.3 Coordination

On April 18, 1984, an initial Consultation and Coordination Officer's (CCO) meeting was held to explain the nature and purpose of the study, to outline the scope and limits of the work, and to obtain flood information concerning the community. This meeting was attended by representatives of FEMA, the township, and Benatec Associates, Inc. (the study contractor). On June 20, 1986, a final CCO meeting was held with representatives of FEMA, the township, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Manor, Armstrong County, Pennsylvania. The Boroughs of Ford City, Manorville, and Ford Cliff, which lie entirely within the corporate limits of Manor, are not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods within the community: the Allegheny River, from the confluence of Crooked Creek to the upstream corporate limits; Crooked Creek, from its confluence with the Allegheny River to a point approximately 1,650 feet upstream of State Route 66; Garretts Run, from its confluence with the Allegheny River to the upstream corporate limits; Campbell Run, from its confluence with Crooked Run to a point approximately 1,145 feet upstream of State Route 66; and Fort Run, from its confluence with the Allegheny River to a point approximately 445 feet upstream of Township Route 447. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through December 1990.

Rupp Run, Graff Hollow, Tub Mill Run, Cowanshannock Creek, several unnamed streams, and the remaining portions of Crooked Creek, Campbell Run, and Fort Run were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Manor.

2.2 Community Description

The Township of Manor is located in west-central Armstrong County in the Commonwealth of Pennsylvania. It is bordered by the Township of Kittanning to the east, the Township of Rayburn and the Borough of Kittanning to the north, the Township of Bethel to the south, and the Township of North Buffalo to the west. The population of the township was 4,819 in 1980, a decrease of 211 from the 1970 census (Reference 1).

In addition to the three small boroughs located within the corporate limits of the township, two areas under the jurisdiction of other governing bodies are also located within Manor. These areas include: the site of the Ford City wastewater treatment facility located near the mouth of Fort Run, which is under the jurisdiction of Ford City; and a portion of Crooked Creek State Park located along the southern boundary of the township, which is under the jurisdiction of the Commonwealth of Pennsylvania.

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FIGURE 1

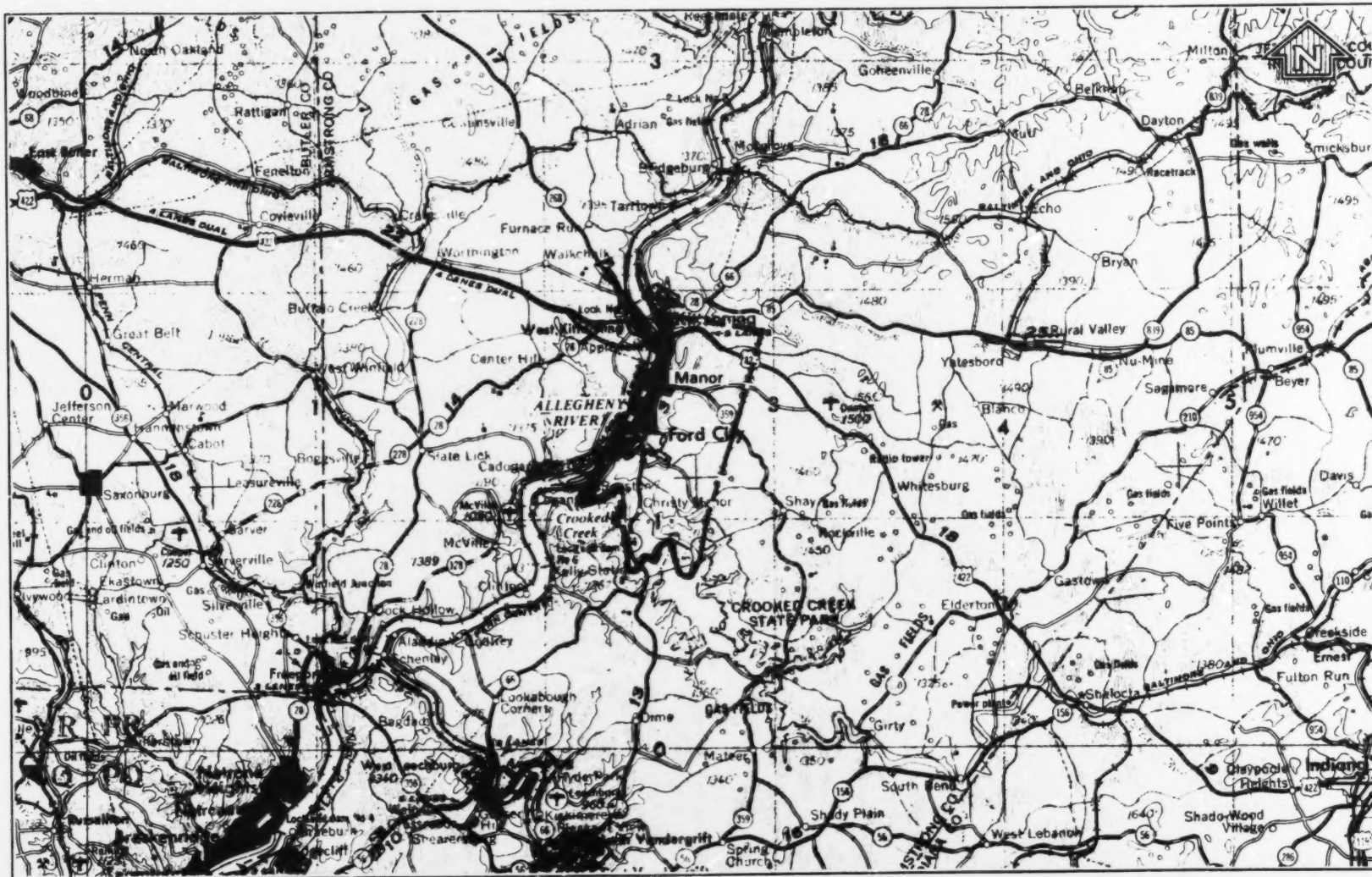
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANOR, PA
(ARMSTRONG CO.)

APPROXIMATE SCALE



VICINITY MAP



Manufacturing makes up the largest percentage of the civilian work force within the community, followed by retail/wholesale and service-oriented occupations.

The climate of the area is humid continental, with average temperatures ranging from 48 to 50 degrees Fahrenheit (°F). Annual precipitation is between 40 to 44 inches. Summers are pleasant and warm with thunder-showers occurring on the average of 22 days between June and August. Fall is the driest time of the year; however, dry periods rarely exceed 2 to 3 weeks. Winter usually brings 1-inch or more of snow cover for approximately 50 days each season.

Local weather patterns of the area are generally topographically controlled. The topography is rolling and hilly with elevations ranging from 900 to 1,200 feet. There are three main soil associations found within the township. The Weikert-Gilpin association is well-drained, shallow and moderately-deep, steep and very steep soils generally found on uplands (Reference 2). The Gilpin-Weikert-Ernest association is well-drained, shallow to deep, gently-sloping to moderately-steep soils generally found on benches, ridges, and hillsides (Reference 2). The Rainsboro-Melvin-Steff association is moderately well-drained to poorly-drained, deep, nearly-level to gently-sloping soils generally found on terraces and floodplains.

2.3 Principal Flood Problems

Past flooding records in the vicinity of the Township of Manor indicate that major flooding occurs at various times of the year. However, the main flood season is typically December through April, resulting from heavy spring rains and snow melt. Floods occurring during the summer are rare and are sometimes associated with tropical storms.

The maximum flood of record in Armstrong County downstream of Kittanning occurred in March 1913, with the Allegheny River delivering a discharge of 269,000 cubic feet per second (cfs). These floodwaters caused damage to buildings and other structures within the area. The estimated 100-year discharge for the Allegheny River in the Township of Manor is 215,500 cfs.

The maximum known flood on Crooked Creek occurred in March 1936, with a discharge of 21,000 cfs. This flood was prior to the U. S. Army Corps of Engineers (COE) construction of the flood control dam on Crooked Creek, which was completed in 1940. The maximum 100-year discharge for Crooked Creek is 5,790 cfs where it discharges into the Allegheny River. The discharge is primarily the result of a controlled release of 5,000 cfs from the Crooked Creek Flood Control Dam. It was designed to contain a discharge of 7,500 cfs within the banks of Crooked Creek below the dam;

however, when a maximum of 5,000 cfs was released from the reservoir during the June 1972 flood, some newer homes downstream of the dam were on the verge of sustaining basement flooding. As a result of this minor flooding, 5,000 cfs is now considered the maximum safe release for Crooked Creek (Reference 3).

U. S. Geological Survey (USGS) gages exist on the Allegheny River and Crooked Creek; information from these gages were used in the analyses of these streams. Records at USGS gage station No. 03049500, located 520 feet upstream from a dam at lock No. 4 on the Allegheny River in Allegheny County at Watrona have been maintained from October 1938 to date. Records at USGS gage station No. 03036500, located 5.7 miles upstream from Crooked Creek on the Allegheny River in Armstrong County have been maintained from August 1904 to 1928 and October 1934 to date. Records of USGS No. 03039000, located 0.4 mile downstream from Crooked Creek Dam on Crooked Creek in Armstrong County have been maintained from October 1909 to date (Reference 4).

At the time of this study, there are no high-water marks or principal flood problems for Garretts Run, Fort Run, or Campbell Run. The maximum 100-year discharge for these streams is 3,225 cfs, 1,145 cfs, and 2,395 cfs, respectively.

2.4 Flood Protection Measures

There are several dams and reservoirs existing within the Allegheny River basin that act to reduce flood levels on the Allegheny River within Armstrong County. These structures were built and are operated by the COE to reduce major flood crests for several downstream communities.

Crooked Creek Lake controls approximately 95 percent of the total drainage area for Crooked Creek. The Crooked Creek Flood Control Dam provides virtually complete flood protection for the areas between the dam and the Allegheny River.

There are currently no flood control structures known to exist on Garretts Run, Campbell Run, or Fort Run at this time.

Nonstructural measures of flood protection are being implemented to aid in the prevention of future flood damage. These measures are in the form of land-use regulations that control planning and building activities within areas having a high risk of flooding.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard

data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The data for the hydrologic analyses of the Allegheny River and Crooked Creek were based on records of river stages and discharges from gage stations located on the Allegheny River and Crooked Creek. These USGS gages include: Gage No. 030349500 and Gage No. 03036500 on the Allegheny River, and Gage No. 03039000 on Crooked Creek.

Peak discharges for the Allegheny River were calculated using a log-Pearson analysis to develop discharge-frequency curves for the Allegheny River basin (Reference 5).

Discharges for Crooked Creek are regulated by a COE flood control dam located approximately 0.5 mile upstream of stream Gage No. 03039000. This dam controls a 277 square mile drainage area. Normal operating procedures for this dam is to close the gates during the passage of a storm, releasing only 200 to 300 cfs. After the storm has passed and the hydrograph is well into the recession part of the curve, the gates are opened to release a maximum of 5,000 cfs, returning the reservoir to normal pool level quickly (Reference 3). Discharges for the uncontrolled portion of this stream do not exceed 5,000 cfs for the 10-, 50-, and 100-year floods. The recommended discharges for the 500-year flood was computed by adding the 500-year flow from the dam's discharge frequency curve to the 500-year flow for the uncontrolled area, which was calculated using COE multiple regression formula developed for streams in the Ohio River Basin (Reference 6).

Peak flows for the 10-, 50-, 100-, 500-year floods for Garretts Run, Fort Run, and Campbell Run were calculated using the COE multiple regression formula developed for streams in the Ohio River basin (Reference 6).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
ALLEGHENY RIVER					
At upstream corporate limits	8,973.00	152,000	196,000	215,500	261,000
CROOKED CREEK					
At confluence with Allegheny River	292.00	5,790	5,790	5,790	24,050
Above confluence with Homewood Tributary	290.89	5,735	5,735	5,735	23,920
Above confluence with Manor Heights Tributary	289.48	5,655	5,655	5,655	23,685
Above confluence with Campbell Run	282.56	5,270	5,270	5,270	20,960
Above confluence with Bethel School Tributary	280.93	5,195	5,195	5,195	20,445
Approximately 3,300 feet upstream of State Route 66	279.96	5,140	5,140	5,140	19,905
At USGS Gage No. 03039000	278.00	5,040	5,040	5,040	18,965
GARRETTS RUN					
At confluence with Allegheny River	8.80	1,330	2,500	3,225	5,155
Above confluence with Second Tributary	6.7	1,095	2,102	2,730	4,435
Above confluence with Rupp Run	3.69	685	1,355	1,755	2,885
East of corporate limits	2.67	550	1,110	1,445	2,425
CAMPBELL RUN					
At confluence with Crooked Creek	6.12	990	1,865	2,395	3,830

TABLE 1 - SUMMARY OF DISCHARGES - continued

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA (sq. miles)</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
FORT RUN					
At confluence with Allegheny River	1.90	425	870	1,145	1,935

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses of the streams studied by detailed methods were obtained from aerial photographs at a scale of 1:12,000 (Reference 7). The below-water sections were obtained by field measurement. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 8). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for the Allegheny River were taken from the Flood Insurance Study for the Borough of Freeport (Reference 9). Starting water-surface elevations for Crooked Creek, Garretts Run, Campbell Run, and Fort Run were calculated using the slope/area method.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas (Reference 10). The channel "n" and overbank "n" values for the streams studied by detailed methods are shown in the following tabulation:

<u>Stream</u>	<u>Channel "n"</u>	<u>Overbank "n"</u>
Allegheny River	0.020-0.033	0.040-0.070
Crooked Creek	0.030	0.070-0.085
Garretts Run	0.050-0.080	0.085-0.150
Campbell Run	0.050-0.075	0.100-0.160
Fort Run	0.030-0.070	0.080-0.120

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 11).

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for the Township of Manor, topographic maps, and soil survey information (References 12, 11, and 2).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood

hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for the Allegheny River and Crooked Creek extend beyond the corporate limits.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH ² (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Allegheny River								
A	550	1,601	40,713	5.3	787.2	787.2	787.4	0.2
B	2,020	1,452	37,365	5.8	787.4	787.4	787.6	0.2
C	4,530	822	25,953	8.3	787.5	787.5	787.7	0.2
D	4,759	752	25,288	8.5	787.5	787.5	787.7	0.2
E	5,609	706	22,858	9.4	787.6	787.6	787.8	0.2
F	6,359	717	22,170	9.7	787.8	787.8	788.0	0.2
G	7,559	689	22,941	9.4	788.3	788.3	788.5	0.2
H	8,729	833	24,765	8.7	788.9	788.9	789.1	0.2
I	10,329	826	26,604	8.1	789.5	789.5	789.7	0.2
J	11,829	940	27,133	7.9	789.9	789.9	790.1	0.2
K	13,479	1,270	29,880	7.2	790.6	790.6	790.8	0.2
L	14,349	1,360	37,389	5.8	791.1	791.1	791.3	0.2
M	15,949	1,334	38,198	5.6	791.5	791.5	791.7	0.2
N	17,449	942	30,227	7.1	791.6	791.6	791.8	0.2
O	19,349	828	29,167	7.4	792.0	792.0	792.2	0.2
P	19,646	714	24,970	8.6	792.0	792.0	792.2	0.2
Q	21,096	693	22,861	9.4	792.0	792.0	792.3	0.3
R	22,596	889	24,987	8.6	792.7	792.7	793.0	0.3
Crooked Creek								
A	0	240	1,692	3.4	787.2	771.1 ³	772.1	1.0
B	250	240	1,497	3.9	787.2	771.2 ³	772.2	1.0
C	2,200	241	1,616	3.6	787.2	772.6 ³	773.1	0.5

¹Feet above corporate limits²This width extends beyond corporate limits³Elevation computed without consideration of backwater from Allegheny River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF MANOR, PA
 (ARMSTRONG CO.)

FLOODWAY DATA

ALLEGHENY RIVER - CROOKED CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Crooked Creek (continued)								
D	4,450 ¹	232 ³	1,429	4.1	787.2	773.9 ⁴	774.1	0.2
E	6,400 ¹	190 ³	1,470	3.9	787.2	775.0 ⁴	775.2	0.2
F	7,950 ¹	161 ³	1,349	4.3	787.2	775.7 ⁴	775.8	0.1
G	9,480 ¹	154 ³	884	6.5	787.2	776.7 ⁴	776.8	0.1
H	11,020 ¹	160 ³	1,136	5.0	787.2	778.7 ⁴	778.8	0.1
I	12,650 ¹	165 ³	1,012	5.6	787.2	780.2 ⁴	780.3	0.1
J	14,280 ¹	170 ³	1,088	5.2	787.2	782.0 ⁴	782.1	0.1
K	15,550 ¹	176 ³	930	6.1	787.2	783.5 ⁴	783.6	0.1
L	17,135 ¹	112 ³	859	6.6	787.2	785.7 ⁴	786.0	0.3
M	18,935 ¹	143 ³	1,013	5.2	787.7	787.7	788.2	0.5
N	19,935 ¹	135 ³	990	5.3	788.7	788.7	789.1	0.4
O	21,085 ¹	137 ³	1,073	4.9	789.7	789.7	790.0	0.3
P	22,422 ¹	126 ³	1,110	4.7	790.7	790.7	791.6	0.9
Q	24,052 ¹	145 ³	893	5.9	792.4	792.4	792.9	0.5
R	25,832 ¹	167 ³	1,090	4.8	794.8	794.8	795.0	0.2
S	26,077 ¹	118 ³	1,054	4.9	794.9	794.9	795.9	1.0
T	27,577 ¹	138 ³	857	6.0	796.5	796.5	797.1	0.6
Garretts Run								
A	0 ²	24	237	13.6	792.0	780.3 ⁴	781.2	0.9
B	90 ²	100	871	3.7	792.0	785.3 ⁴	785.3	0.0
C	392 ²	49	440	7.3	792.0	789.3 ⁴	790.1	0.8
D	662 ²	34	335	9.6	792.0	791.3 ⁴	791.8	0.9

¹Feet above corporate limits

²Feet above confluence with Allegheny River

³This width extends beyond corporate limits

⁴Elevation computed without consideration of
backwater from Allegheny River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANOR, PA

(ARMSTRONG CO.)

FLOODWAY DATA

CROOKED CREEK - GARRETTS RUN

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Garretts Run (continued)								
E	1,027	127	667	4.8	795.4	795.4	796.3	0.9
F	1,602	47	362	8.9	799.8	799.8	800.1	0.3
G	1,832	50	392	8.2	803.3	803.3	803.8	0.5
H	2,397	37	300	10.8	812.3	812.3	812.4	0.1
I	2,619	41	448	7.2	817.1	817.1	817.9	0.8
J	2,869	33	313	10.3	819.9	819.9	820.3	0.4
K	3,279	43	446	7.2	827.1	827.1	827.4	0.3
L	3,516	132	820	3.9	832.1	832.1	832.4	0.3
M	4,206	35	275	11.7	834.6	834.6	834.9	0.3
N	4,446	89	490	6.6	840.6	840.6	840.7	0.1
O	4,656	36	311	10.4	841.7	841.7	842.4	0.7
P	4,956	71	666	4.8	845.5	845.5	846.3	0.8
Q	5,246	32	261	12.4	847.5	847.5	848.2	0.7
R	5,681	180	1,101	2.9	855.9	855.9	856.6	0.7
S	5,911	165	804	4.0	857.6	857.6	858.0	0.4
T	6,126	110	461	7.0	860.3	860.3	860.6	0.3
U	6,343	191	1,449	2.2	867.3	867.3	867.3	0.0
V	6,833	111	646	5.0	868.3	868.3	868.4	0.1
W	7,083	126	659	4.9	870.1	870.1	870.3	0.2
X	7,658	112	501	6.4	874.8	874.8	875.0	0.2
Y	7,888	56	406	8.0	878.3	878.3	878.5	0.2
Z	8,198	70	715	4.5	882.7	882.7	883.2	0.5

¹Feet above confluence with Allegheny River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF MANOR, PA
(ARMSTRONG CO.)

FLOODWAY DATA

GARRETTS RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
(FEET NGVD)								
Garretts Run (continued)								
AA	8,433	91	855	3.8	883.3	883.3	884.1	0.8
AB	8,668	136	728	4.4	884.6	884.6	885.3	0.7
AC	9,045	75	433	7.5	888.4	888.4	889.4	1.0
AD	9,815	171	964	2.8	896.9	896.9	897.9	1.0
AE	10,345	77	499	5.5	899.7	899.7	900.5	0.8
AF	10,645	100	481	5.7	903.0	903.0	903.5	0.5
AG	11,345	85	323	5.4	912.4	912.4	912.9	0.5
AH	11,575	183	1,095	1.6	919.5	919.5	919.5	0.0
AI	11,975	70	246	7.1	920.6	920.6	921.1	0.5
AJ	12,205	145	545	3.2	925.1	925.1	925.7	0.6
AK	12,455	167	394	4.5	929.4	929.4	929.6	0.2
AL	12,805	96	383	4.6	935.8	935.8	936.0	0.2
AM	13,005	148	401	4.4	938.5	938.5	938.7	0.2
AN	13,455	45	266	6.6	945.8	945.8	946.1	0.3
AO	14,055	108	371	4.7	957.6	957.6	957.9	0.3
AP	14,385	56	230	7.6	964.1	964.1	964.1	0.0
AQ	15,165	59	314	5.6	976.0	976.0	976.7	0.7
AR	15,885	93	345	5.1	990.9	990.9	991.9	0.0
AS	17,245	48	259	5.6	1,007.3	1,007.3	1,007.7	0.4
AT	17,480	60	330	4.4	1,009.6	1,009.6	1,010.3	0.7
AU	17,715	45	215	6.7	1,012.1	1,012.1	1,012.8	0.7
AV	18,095	68	298	4.8	1,017.3	1,017.3	1,018.1	0.8

¹Feet above confluence with Allegheny River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF MANOR, PA
(ARMSTRONG CO.)

FLOODWAY DATA

GARRETTS RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
(FEET NGVD)								
Garretts Run (continued)								
AW	18,475 ¹	35	192	7.5	1,022.1	1,022.1	1,023.1	1.0
AX	18,722 ¹	80	326	4.4	1,025.7	1,025.7	1,026.3	0.6
Campbell Run								
A	70 ²	310	812	2.8	786.7	785.0 ³	785.8	0.8
B	695 ²	360	740	3.2	788.3	788.3	788.7	0.4
C	945 ²	75	389	6.2	790.7	790.7	791.6	0.9
D	1,120 ²	88	451	5.3	794.3	794.3	794.3	0.0
E	1,355 ²	97	575	4.2	799.8	799.8	800.8	1.0
F	1,740 ²	122	383	6.3	804.2	804.2	805.0	0.8
G	2,305 ²	89	566	4.2	817.4	817.4	818.0	0.6
Fort Run								
A	545 ¹	21	121	9.4	790.6	786.3 ³	786.5	0.2
B	855 ¹	177	441	2.6	790.8	790.8	791.4	0.6
C	970 ¹	25	186	6.2	791.6	791.6	792.1	0.5
D	1,125 ¹	18	139	8.2	792.3	792.3	792.9	0.6
E	1,365 ¹	30	211	5.4	794.9	794.9	795.8	0.9
F	1,585 ¹	18	108	10.6	798.7	798.7	798.7	0.0
G	1,950 ¹	119	445	2.6	804.0	804.0	804.4	0.4

¹Feet above confluence with Allegheny River

²Feet above confluence with Crooked Creek

³Elevation computed without consideration of backwater from Allegheny River

TABLE 2

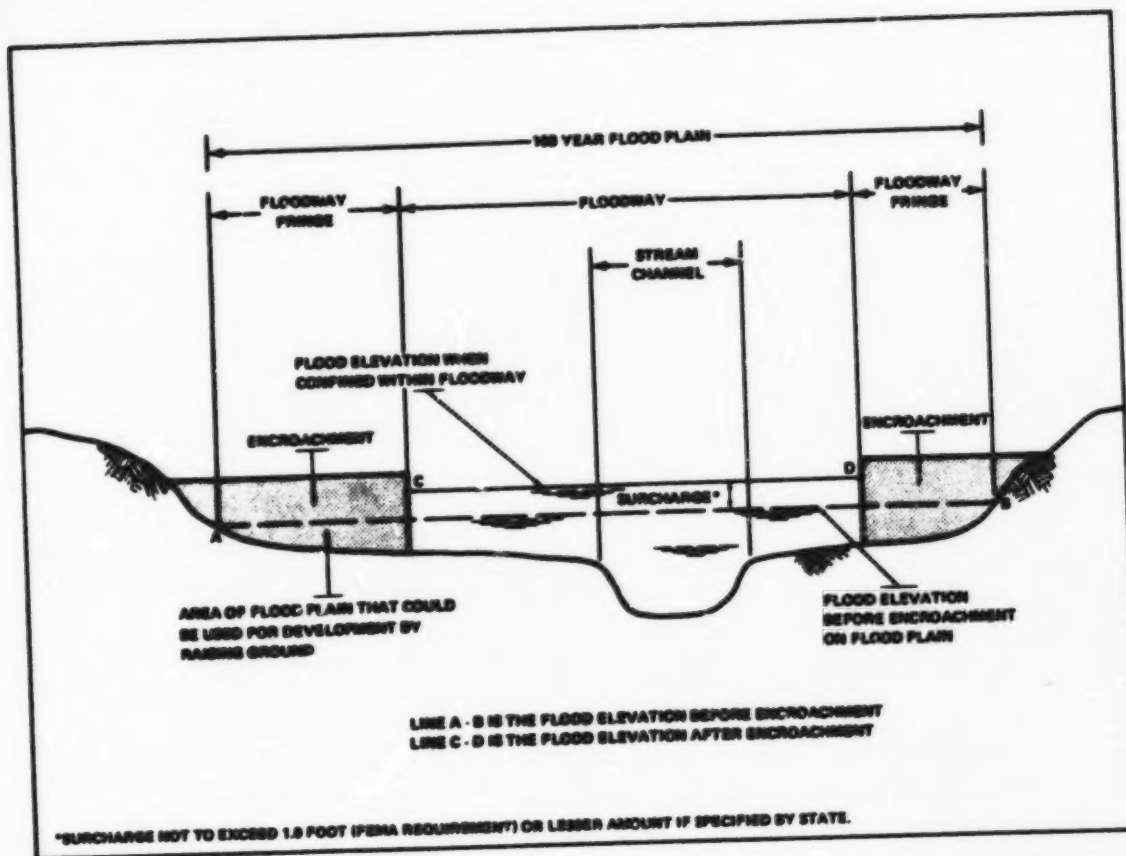
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF MANOR, PA

(ARMSTRONG CO.)

FLOODWAY DATA

GARRETTS RUN - CAMPBELL RUN - FORT RUN



Floodway Schematic

Figure 2

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of Crooked Creek, Garretts Run, Campbell Run, and Fort Run are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

In December 1973, the COE published the Floodplain Information report for Armstrong County (Reference 13). That report covers the Allegheny River from Parker to Freeport and includes both the 100- and 500-year floods. The results of this study agree with the results of the COE study.

In April 1979, the COE published a revised regulation manual for Crooked Creek Lake Reservoir (Reference 3). That manual covers the design information, hydrologic and hydraulic information, emergency regulations, and other pertinent data. A portion of this publication was used in determining the peak discharges from Crooked Creek Reservoir during the 100- and 500-year storms.

Flood Insurance Studies are currently being prepared for the Borough of Freeport, the Township of Kittanning, the Borough of Ford City, and the Borough of Manorville (References 14, 15, 16, 17). The results of those studies will be in exact agreement with the results of this study.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Manor (Reference 12).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

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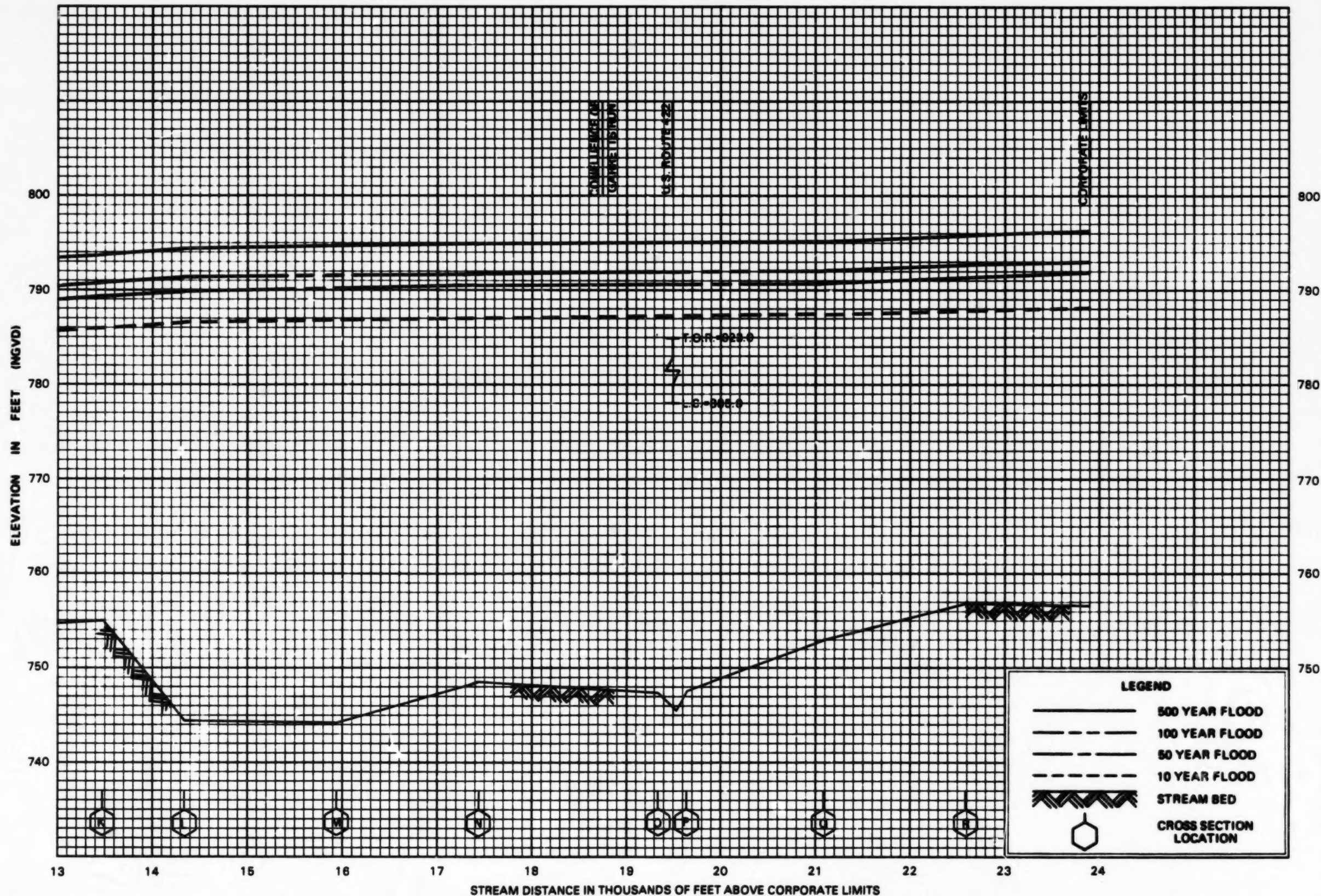
Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17, Washington, D. C., March 1976.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 10	02	788.78	Chiseled square on northwest end of Fourth Avenue bridge over Fort Run.
RM 11	02	791.83	Chiseled square on northwest abutment of T-447 bridge over Fort Run.
RM 12	02	795.03	Chiseled square on southeast guard rail of Fifth Avenue bridge over Fort Run.
RM 13	02	796.13	Chiseled square on northeast headwall of State Route 66 bridge over Fort Run.
RM 14	02	804.07	Chiseled square on southwest guard rial of T-447 bridge over Fort Run.
RM 15	02	1,021.37	Chiseled square on southeast wing wall of State Route 359 bridge over Garretts Run.
RM 16	03	786.01	Standard disk set in abutment of CONRAIL bridge over Crooked Creek.
RM 17	04	795.10	PDH disk set in northeast concrete abutment of State Route 66 bridge over Campbell Run.
RM 18	04	805.74	Chiseled square on southeast abutment of T-522 bridge over Crooked Creek.
RM 19	04	821.28	PDH disk set in southeast guard rail of State Route 66 bridge over Crooked Creek.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 1	01	1,196.93	USC&GS disk stamped N-320 set in center of back wall of catch basin approximately 0.5 mile east of intersection of State Route 66 and old U. S. Route 422.
RM 2	01	929.98	Chiseled square on northeast concrete guard rail of U. S. Route 28 bridge over the Allegheny River.
RM 3	01	816.49	Chiseled square on northeast abutment of State Route 359 bridge over Garretts Run.
RM 4	01	828.10	Chiseled square on steel plate on southwest corner of State Route 359 bridge over Garretts Run.
RM 5	01	838.56	Chiseled square on southeast stone wing wall of State Route 359 bridge over Garretts Run.
RM 6	01	860.92	Chiseled square on southeast abutment of LR 03095 bridge over Garretts Run.
RM 7	01	878.07	Chiseled square on northwest abutment of State Route 359 bridge over Garretts Run.
RM 8	01	886.68	Chiseled square on southwest curb of Hawk Hollow Road bridge over Garretts Run.
RM 9	01	921.76	Chiseled square on northeast abutment of State Route 359 bridge over Garretts Run.



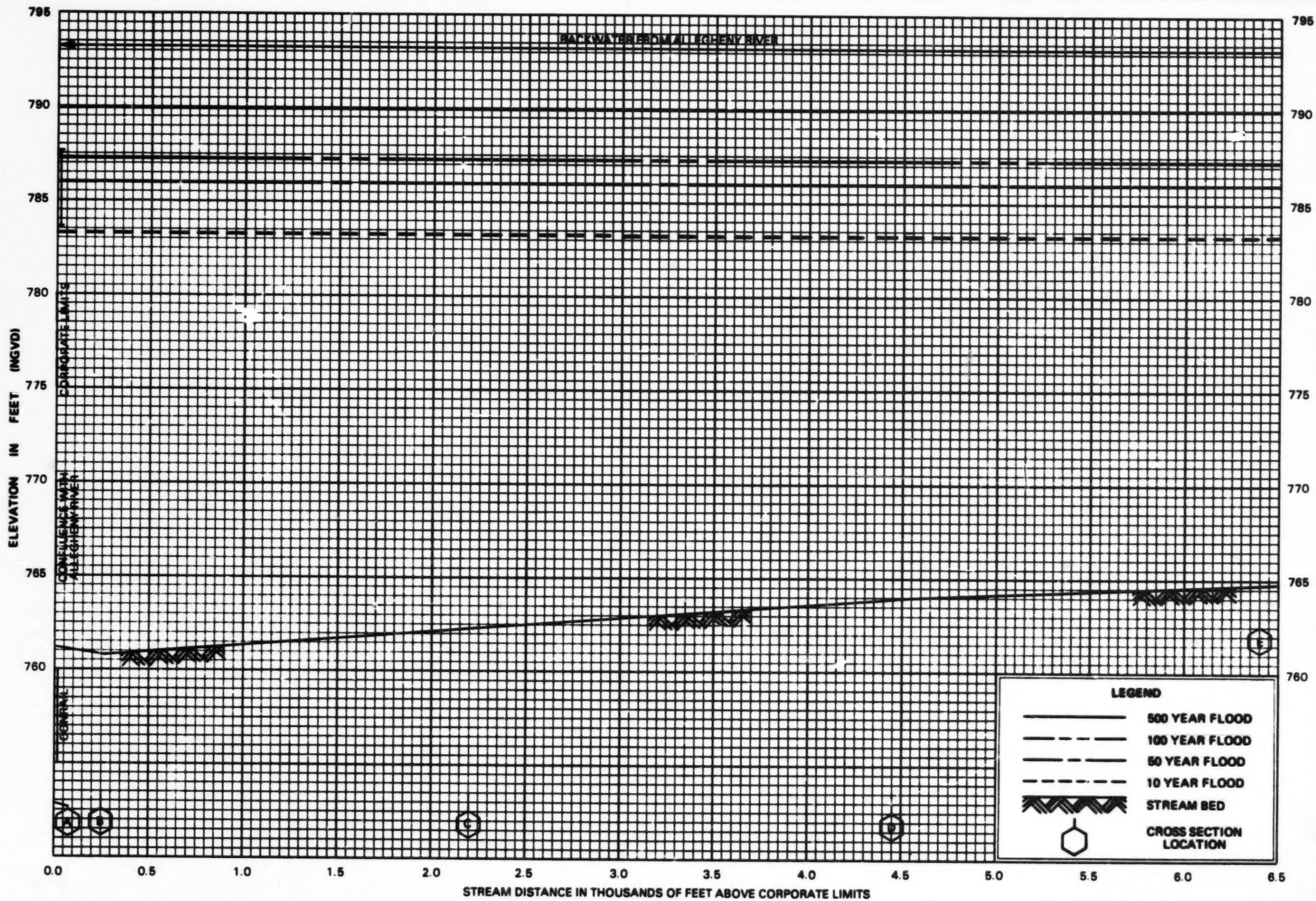
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FLOOD PROFILES

CROOKED CREEK

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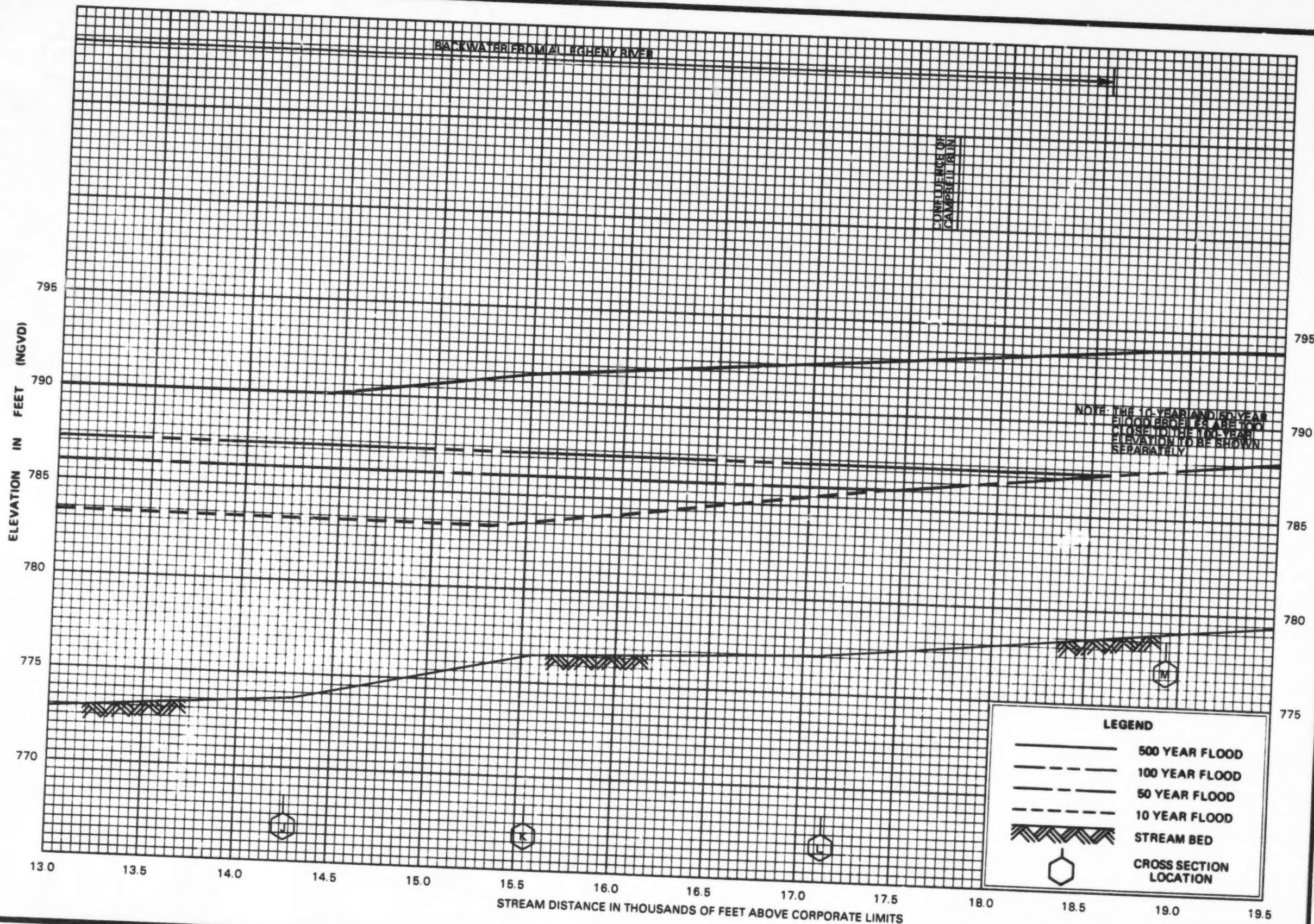
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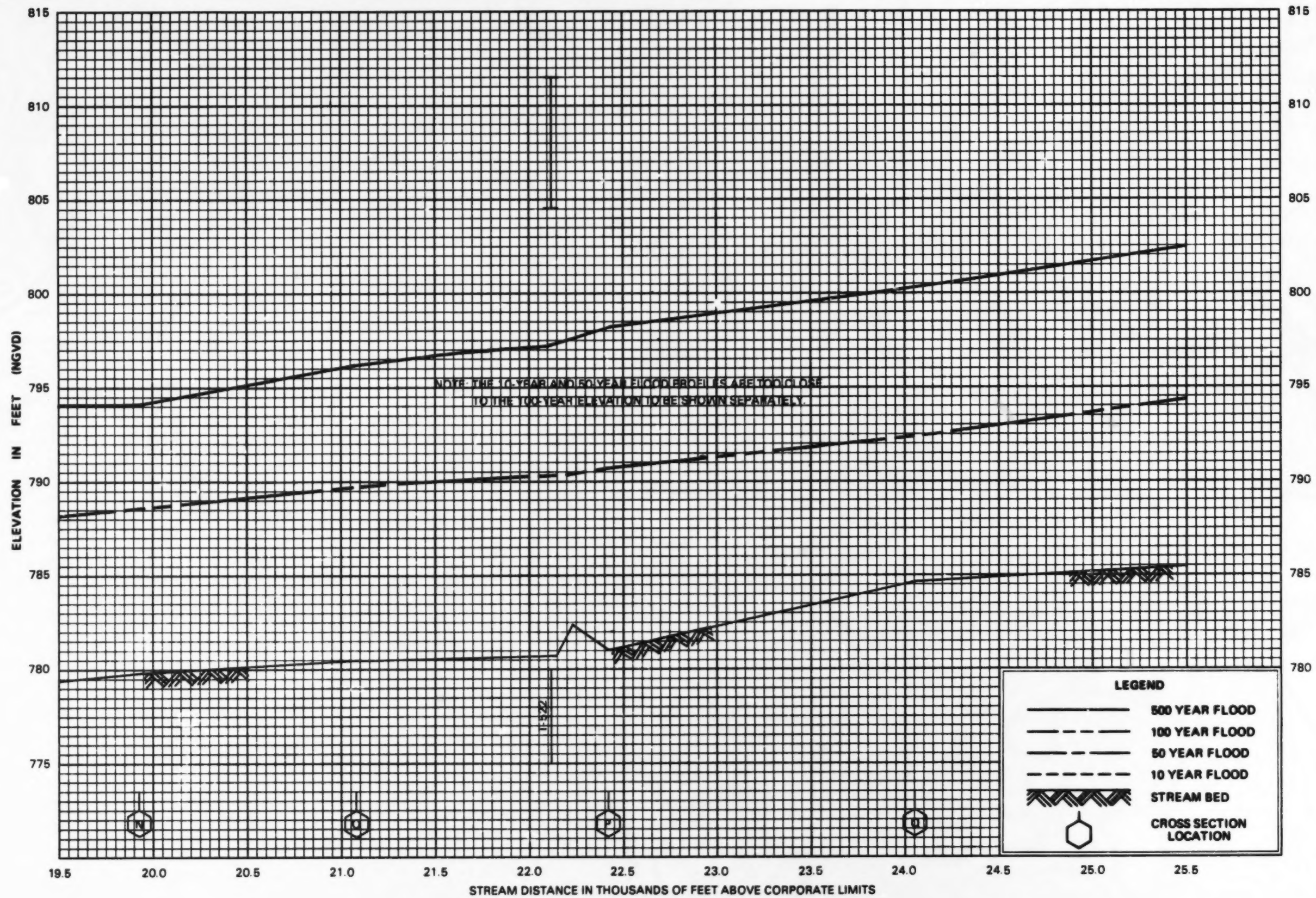
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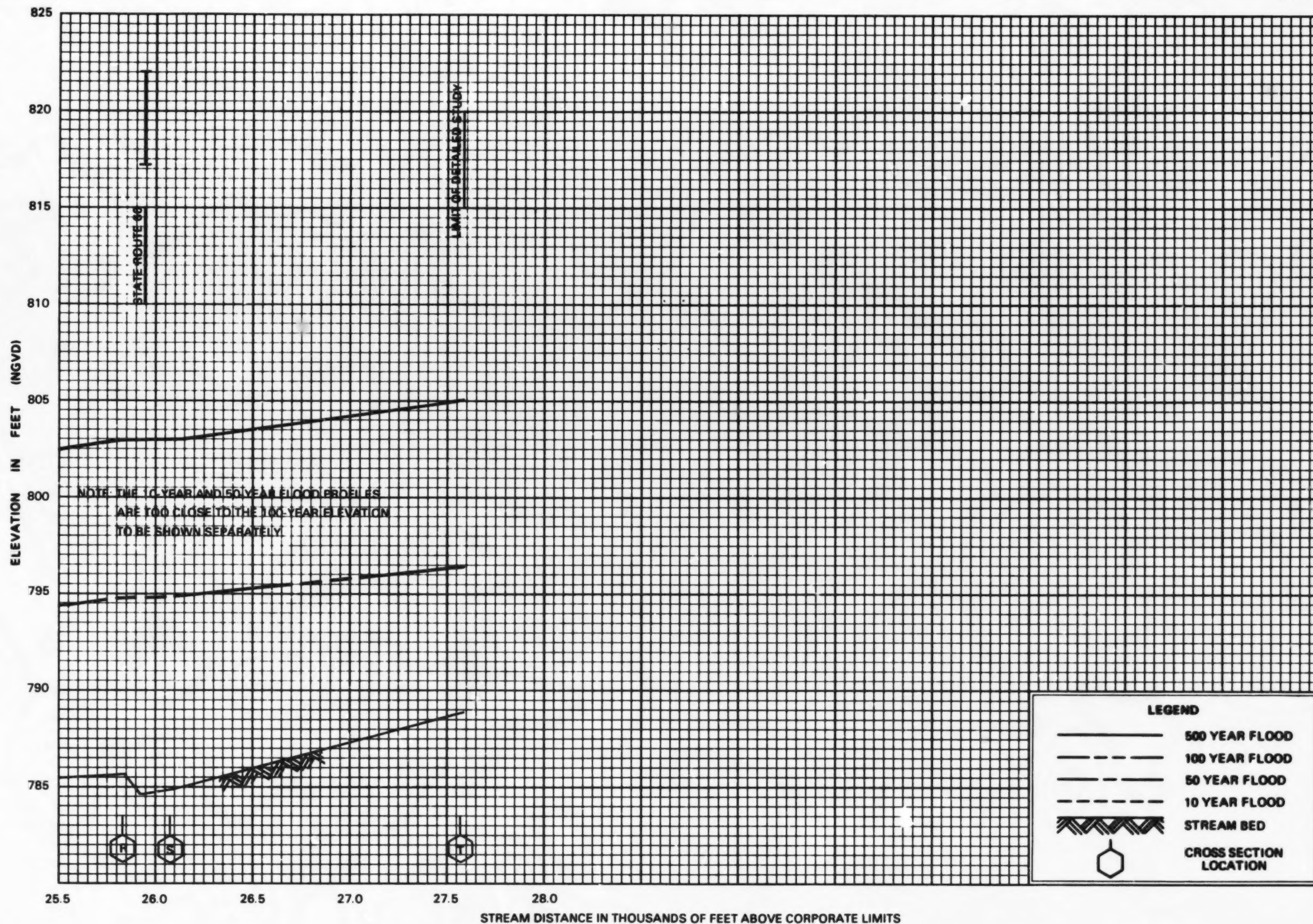
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FLOOD PROFILES
CROOKED CREEK

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TOWNSHIP OF MANOR, PA
(ARMSTRONG CO.)

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FLOOD PROFILES

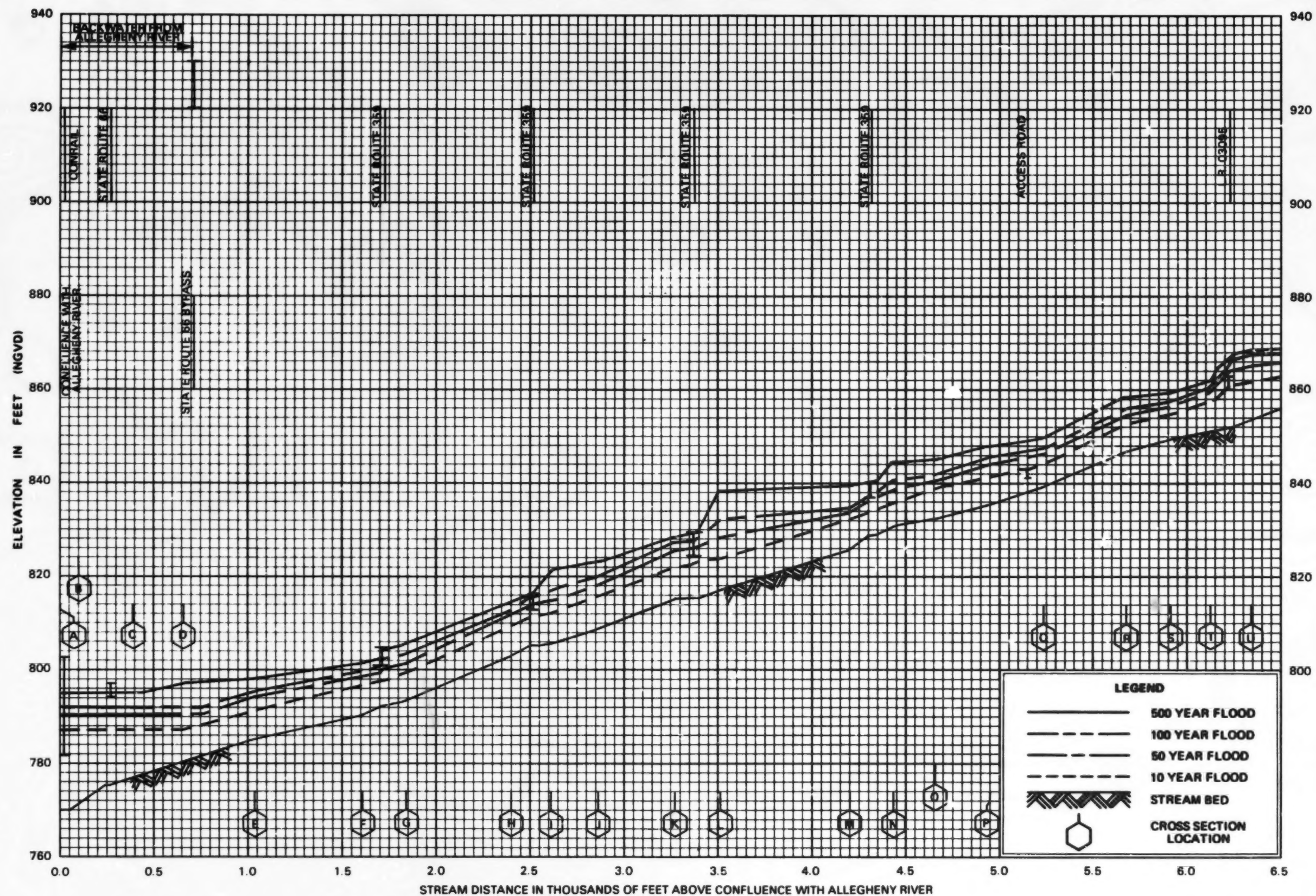
CROOKED CREEK

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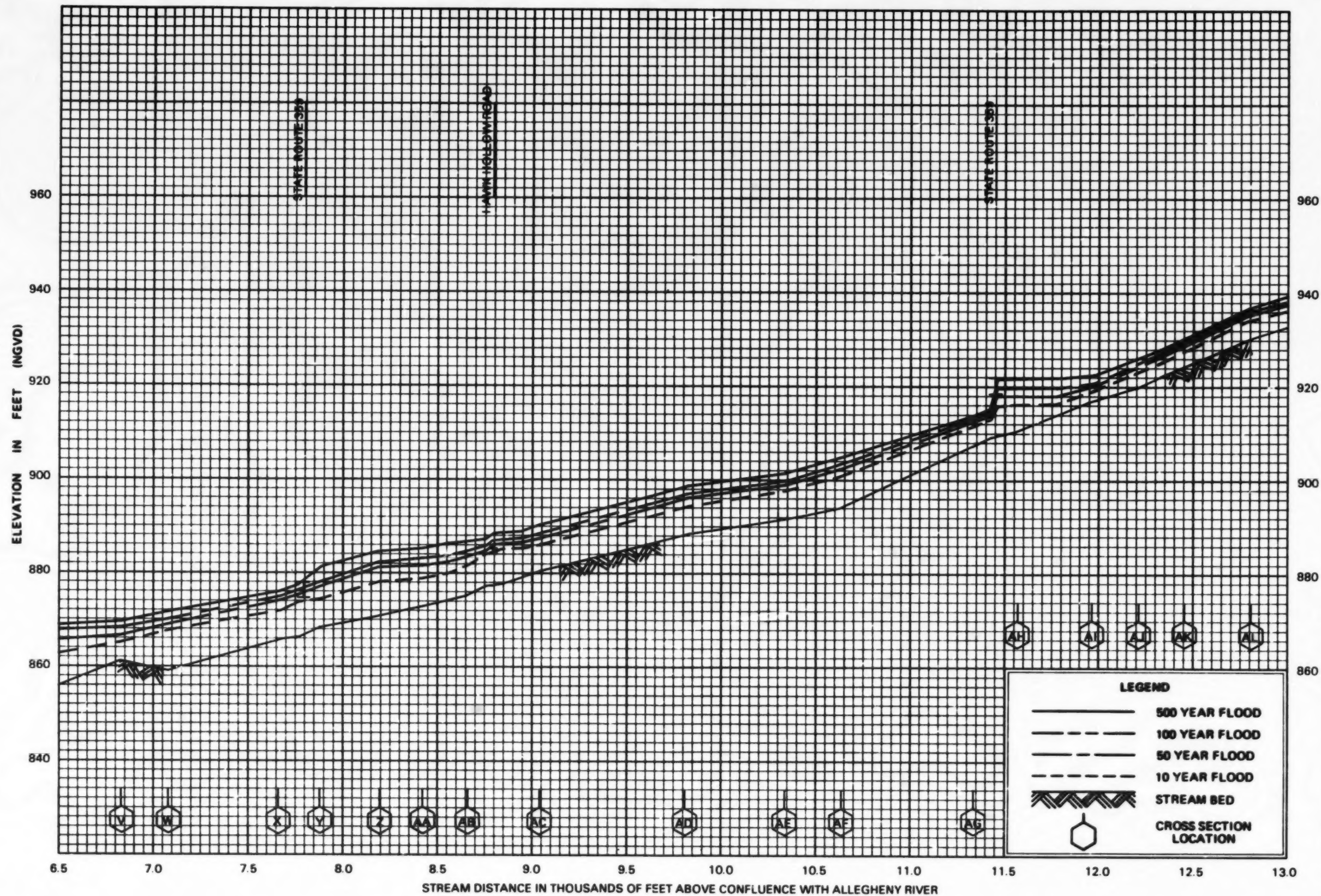
FLOOD PROFILES

GARRETTS RUN

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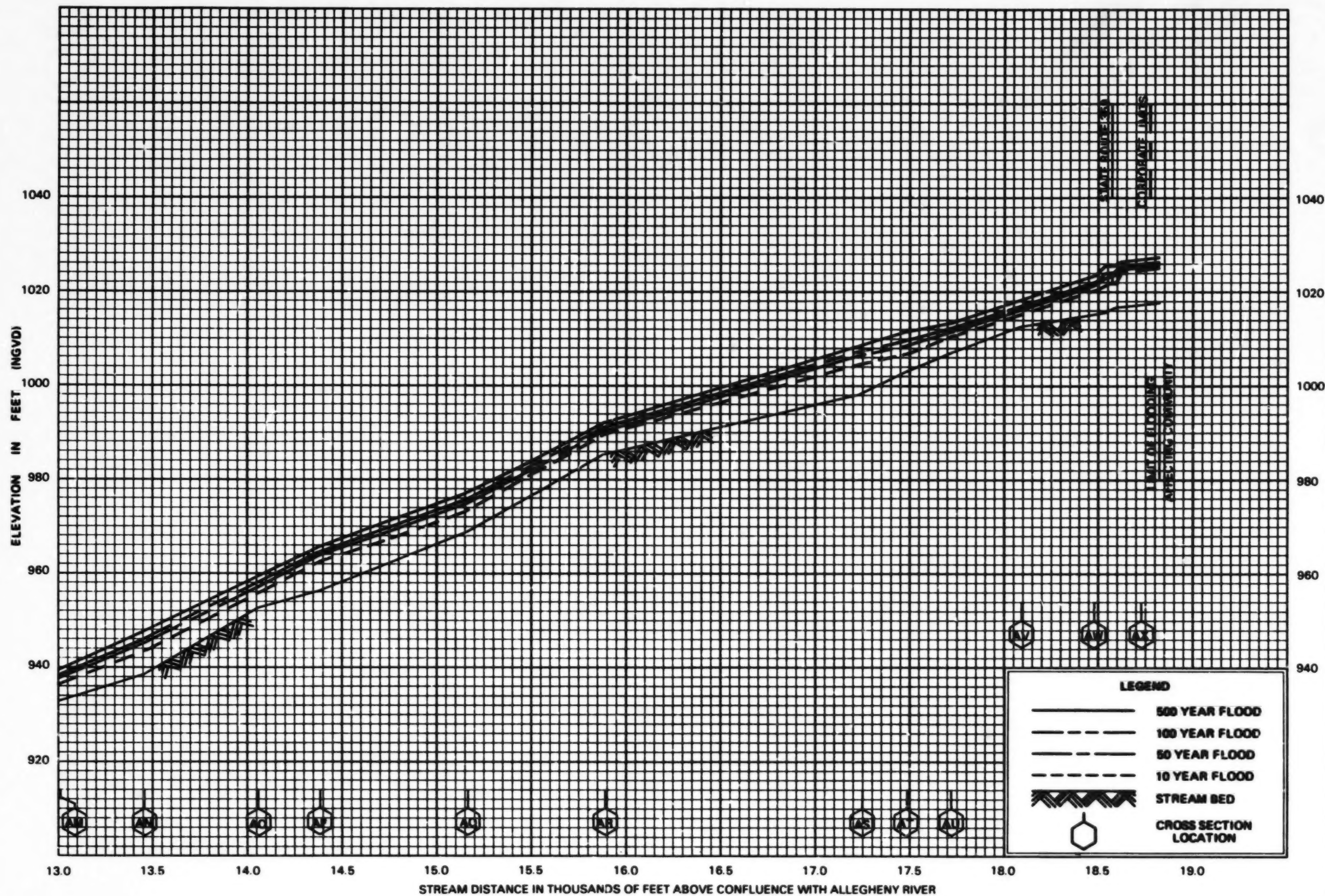
GARRETTS RUN

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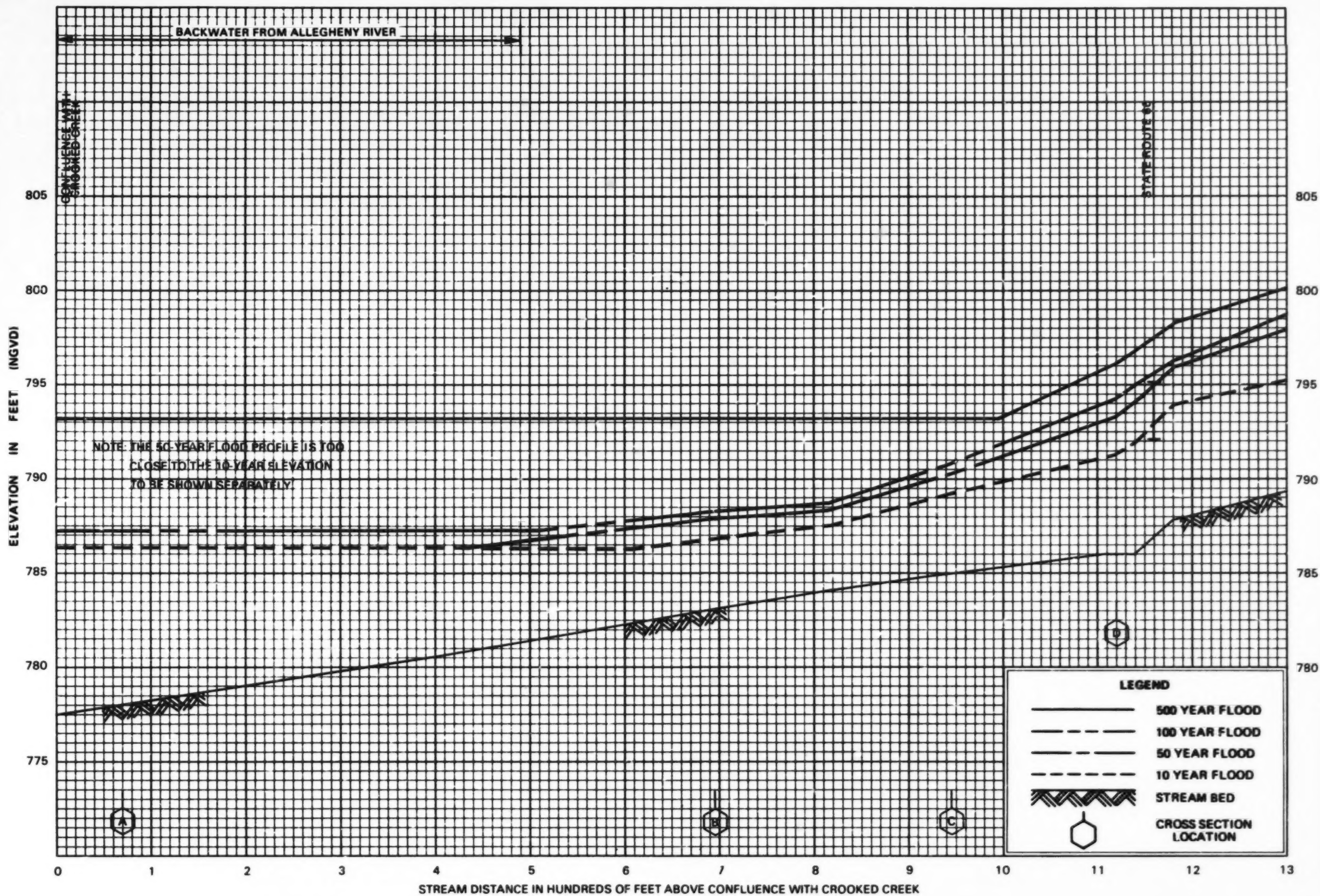
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(ARMSTRONG CO.)

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FLOOD PROFILES

CAMPBELL RUN

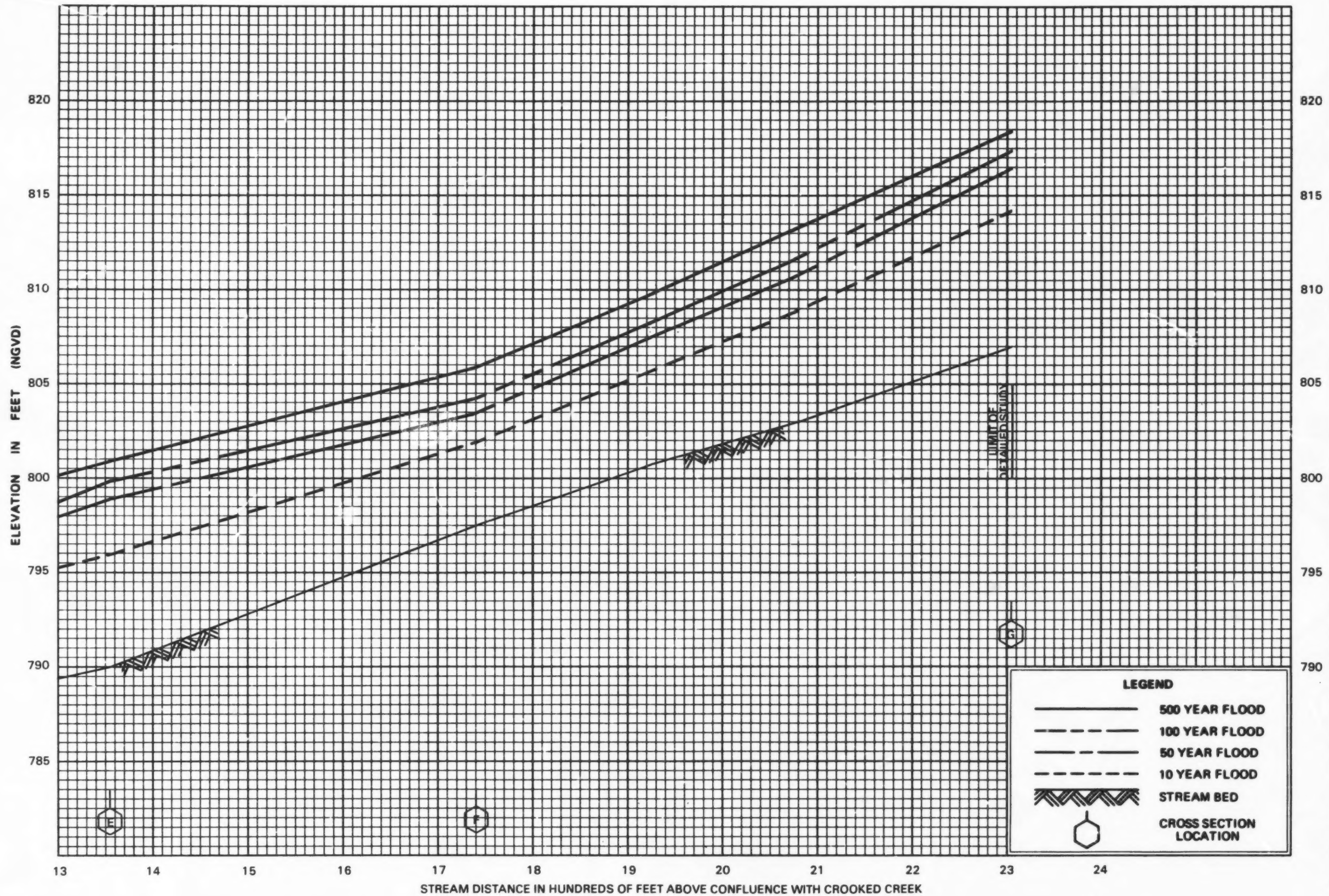
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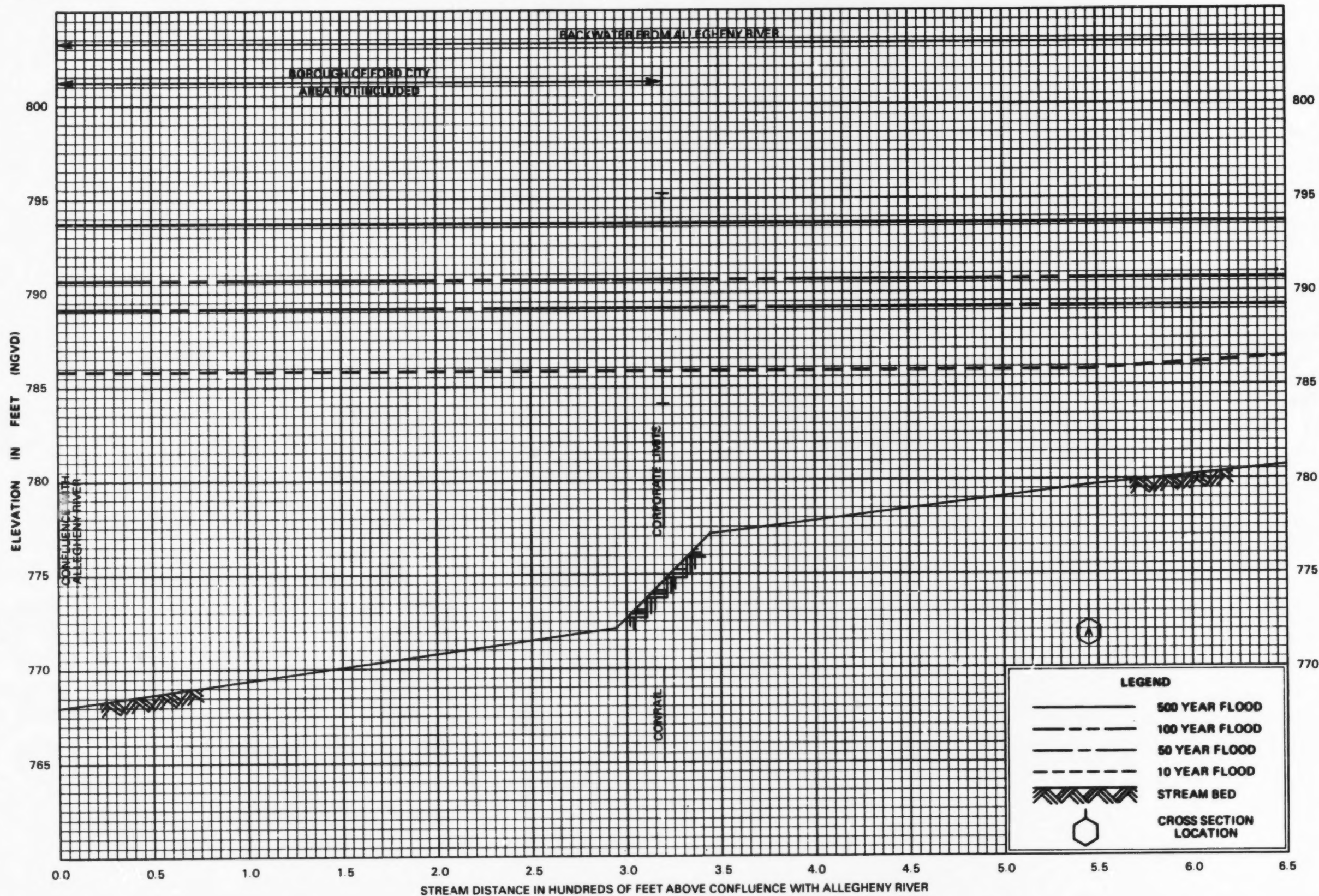
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FLOOD PROFILES
CAMPBELL RUN

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FLOOD PROFILES

FORT RUN

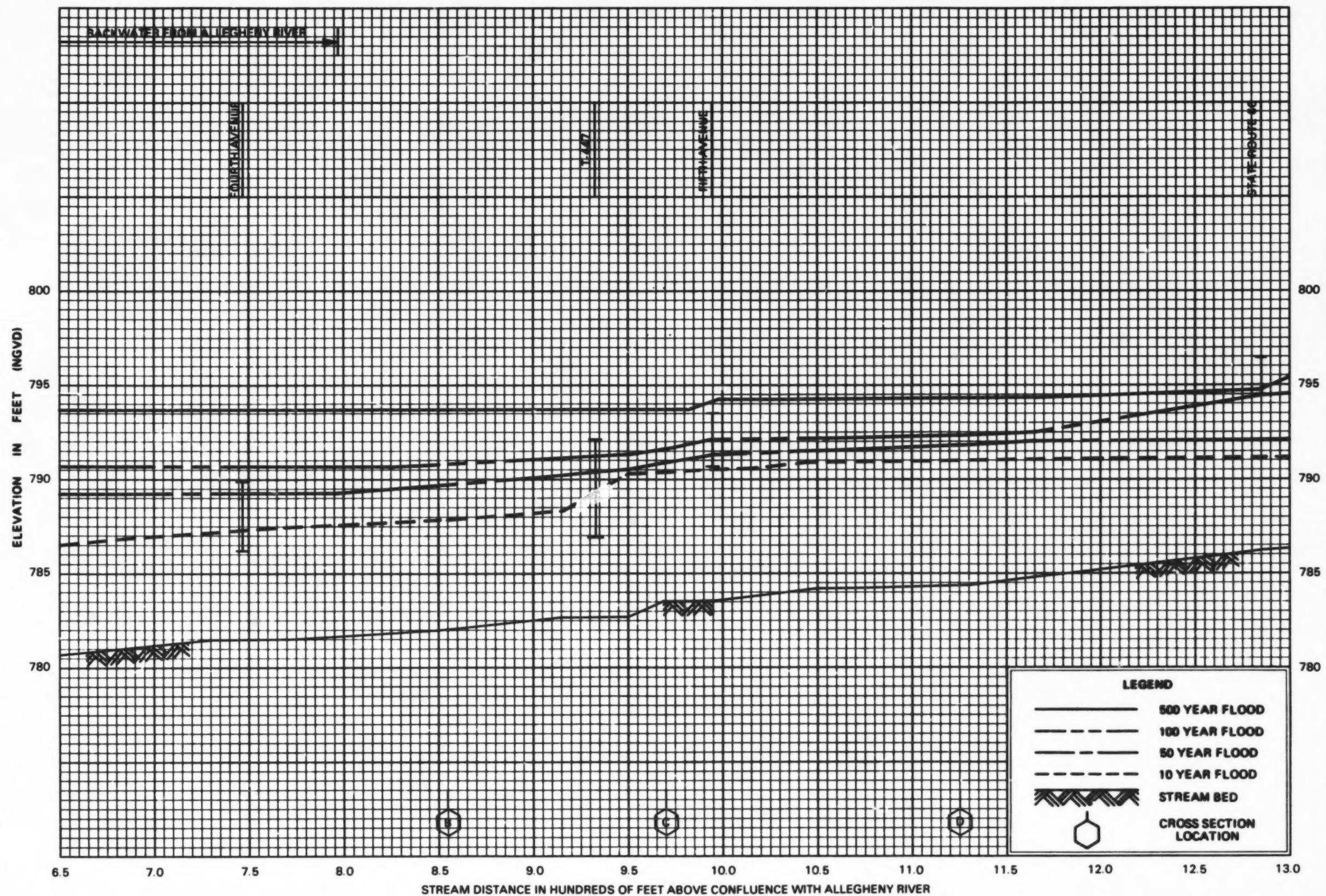
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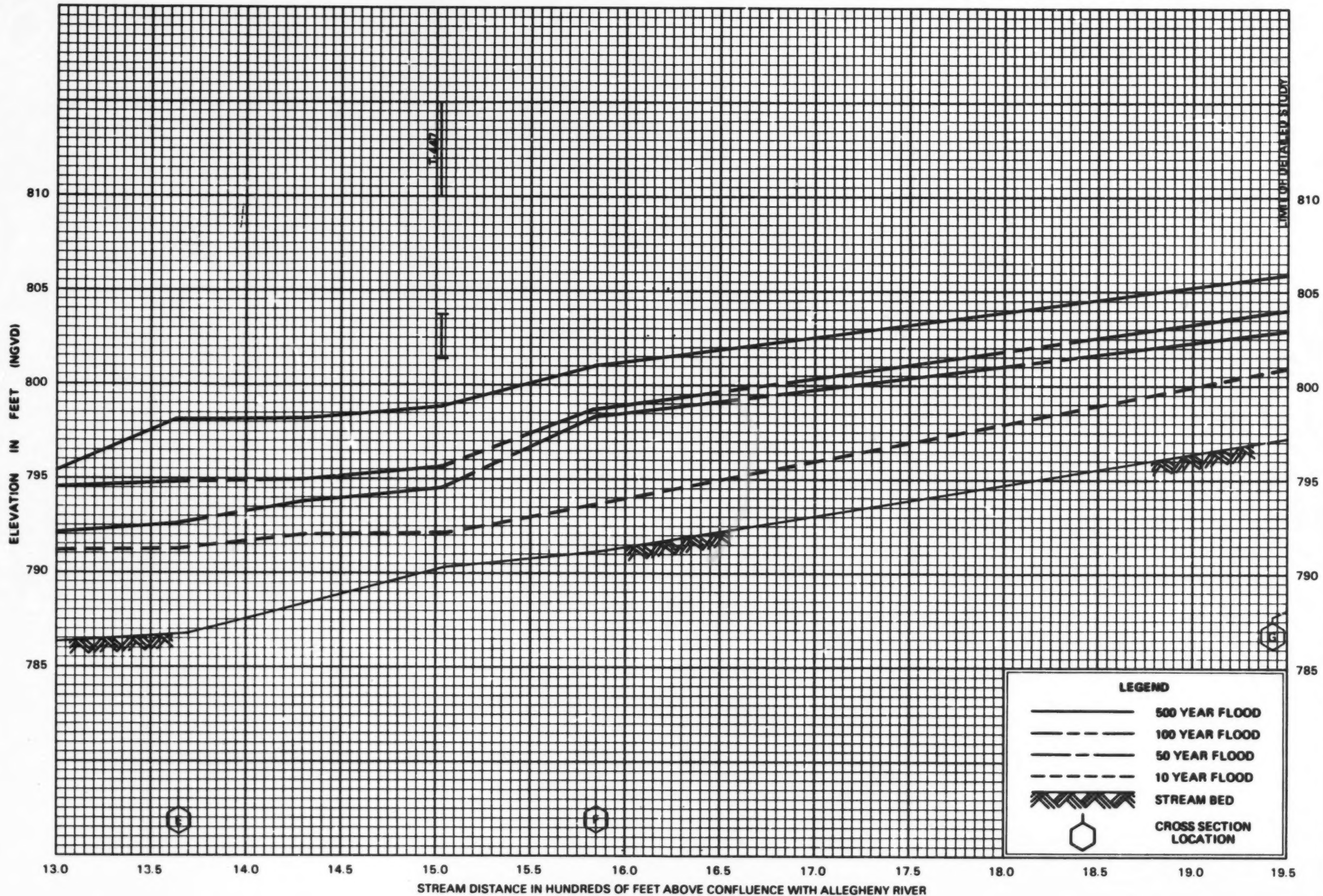
FORT RUN

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FORT RUN

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